

Synopses

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Louise Brearley Messer ANZSPD Post-graduate Essay Competition 2016

Topic

Over the last five years there has been increasing awareness of the role of the labial and lingual frenulae on a neonate's attachment and efficiency during nursing. Discuss the oral physiology of a baby nursing, factors that can decrease a baby's ability to nurse efficiently and problems these cause. Also discuss management options and the possible relation between poor nursing efficacy and the risk of early childhood caries.

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The World Health organisation and The National Health and Medical Research Council (NHMRC) Australia recommends children are exclusively breast fed for six months.¹ Children who are breastfed have increased protection from both acute and chronic infections, reduced risk of obesity and increased cognitive function. Mothers who breastfeed have a lower risk of breast and ovarian cancer.¹ Despite the proven health benefits for both mother and child, the 2010 Australian National Infant Feeding Survey shows that only 15% of baby's are exclusively breast fed at 6 months of age.²

Initiation rates of breast-feeding in Australia are high at 96%, however this drops rapidly after three months.² Numerous factors are at play supporting and limiting breastfeeding. From a physical perspective, the process of feeding involves a series of co-ordinated responses from the child to both latch and effectively draw milk from the breast.³

The oral cavity and child's reflex responses are integral to the physiology of breastfeeding. Firstly, the child needs to find the breast and skin contact with the child's chin brings on the gape reflex. A sufficient gape is quite large, with the appearance of the jaw being unhinged. The size of the jaw and degree of retrognathia is believed to impact the degree of gape (mouth opening), although there are no current studies to quantify this.³ Hoover 19964 showed that when the gape creates a lip angle of around 130 to 160 degrees to accommodate the areola no pain is reported from the mothers during feeding.^{4,5} Achieving this extent of gape requires the child to have their head flexed at least 90 degrees to provide enough room for the jaw to open.⁵

Once there is a sufficient gape, the nipple is guided into position by the tongue, placing the tip of the nipple at the hard-soft palate junction. For this to occur, the tongue first positions forwards over the alveolar ridge and lower lip, then upwards to guide the breast tissue into the mouth⁵ with the sides of the tongue lifting to curve around the breast tissue. Movement of the tongue tip downwards in the mouth creates negative pressure, extracting milk from the breast and movement upwards guides the milk posteriorly to swallow.⁶

Using ultrasound imaging, Geddes^{6,7} has successfully demonstrated that a vacuum and tongue movements (that modulate pressure) are required to extract milk from the breast. For the vacuum to be effective, the seal must be sound.^{3,6} The lips, slightly everted, cover the areola area (at least 2.5-3.8 cm past the nipple⁵) resting passively to provide a seal. The lower lip is flanged completely outward and the upper lip neutral to lightly flanged. Meanwhile the baby's soft palate rises allowing breathing to occur simultaneously.^{1,3}

There are a range of anatomical variations that can impact upon feeding. Specifically two frenulae in the oral cavity have been implicated to potentially hinder the latch and feeding process. Frena within the mouth are understood to be folds of mucous membranes, which may enclose muscle fibres. There are several frenulae present in the oral cavity, most noted being the maxillary labial frenulum and the lingual frenulum. The primary function of these is to provide stability to freely moving structures.³ Missing frenulae (especially in the midline) have been associated with syndromes.⁹

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Colgate Oral Care



Recycling oral care waste

Every year in Australia and New Zealand, over 30 million toothbrushes and 80 million toothpaste tubes* are thrown away. To try and address this issue, Colgate has partnered with TerraCycle, an innovative recycling company that has become a global leader in recycling hard to recycle waste.

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Once the collection box is full, the school simply weighs the box, transfers the waste to a shipping carton, downloads the shipping label from their TerraCycle account and then drops off the box at their local Australia or New Zealand Post Office for free shipping. As an added incentive, Colgate is offering an annual prize of \$1,000 and a park bench made from recycled oral care waste, to the school that recycles the most oral care waste in a calendar year. Last year the Australian winner was Jewells Primary School, Newcastle, NSW. The school collected the most oral care waste in Australia, diverting 4,261 units, or over 38kg, of used oral care waste items from landfill. The New Zealand winning school was Belmont Primary in Auckland who diverted 4,405 units of oral care waste weighing 39.98 kilograms.

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Ankyloglossia (Tongue-tie) is used to describe an unusually thickened, shortened, inelastic frenulum or one that varies in attachment point, often restricting movement.¹⁰ Ankyloglossia is a congenital anomaly that may occur in isolation or with other midline defects⁵, caused by insufficient apoptosis from the floor of the mouth during development of the tongue. Normally, the cells that attach the tongue to the floor of the mouth regress, leaving a thin attachment of oral mucosa known as the lingual frenulum.¹¹ At birth, this region is usually poorly vascularised and innervated.¹¹ The prevalence of ankyloglossia ranges from 0.02% to 10.7% of infants^{12,13} with a male to female ratio of 2.6:1.¹¹

Many combinations of length, placement and elasticity are possible. A number of classifications for ankyloglossia are available (Hazelbaker, Ballard, Coryllos and Griffiths/Hogan) however there is little agreement between the classifications making direct comparisons between studies very difficult. The Hazelbaker Assessment tool for Lingual Frenulum Function (ATLFF) considers five appearance factors and seven function factors scoring each between 0-2, resulting in a total possible score of 14.¹⁴ Tongue-tie is diagnosed if the appearance score is ≤8 or the function score is ≤11.¹⁴ This assessment tool has reported repeatability¹⁵ and also gives indication of the need for intervention. Sub-mucosal tongue ties (also known as posterior tongue ties) are less well defined and challenging to diagnose.⁵

In cases where tongue function becomes restricted, breastfeeding (along with speech and bolus movement) can be impaired.⁵ The link between ankyloglossia and difficulty breastfeeding is well established, with reports around 25% of infants with ankyloglossia¹⁶ present with problems. Although some tongue-tied infants are able to latch and transfer milk⁷ most are less efficient, representing the crucial role the tongue plays in feeding. Prospective and case control studies^{16,17} show that infants with ankyloglossia are twice as likely to have feeding difficulties and cause nipple pain than those without.

If the tongue is unable to extend over lower alveolar ridge, the child is unable to latch or achieve sufficient depth of nipple placement (shallow latch) a myriad of problems may result. Both aerophagia (excessive swallowing of air) and reflux are more likely in children with latching problems leading to colic

and discomfort in the infant.¹⁸⁻²⁰ Excessive sweeping movements of the lips may be seen as a compensation of a tongue-tie induced shallow latch and can cause upper lip blisters for the child.⁵ Other children attach but fail to transfer enough milk, feeding becomes prolonged²¹ and repeated efforts tiring for the infant. Use of additional musculature leads to fatigue.²⁰ Over time children can have reduced weight gain and irritability.^{21,22} Where the tongue is unable to rise and fall, the pressure change and vacuum produced are limited and the infant begins using chewing action or abnormal movements to change pressure gradients, ultimately resulting in both pain and nipple damage for the mother.⁷ Furthermore, difficulties with feeding can reduce maternal milk supply, cause plugged ducts, flattened or compressed nipples and mastitis.^{3,10,23}

As pain has been reported to be the second highest cause of early cessation of breastfeeding this can have significant consequences for the long term health of the child.^{11,23,24} Consequently options to address feeding issues are crucial. Conservative approaches include advice from a lactation consultant, altered position of feeding, use of a nipple shield, craniosacral manipulation, naturopathic consultation and physical therapy.²¹

Surgical management of frenula (frenectomy, frenulotomy or frenuloplasty) involves the division or removal of the tissue. Historically, in the 18th century, midwives released the lingual frenulum with a long fingernail or metal object at birth.^{16,25} Release at birth is considered beneficial as it allows for normal movements of the muscular structure for feeding and the normal development of adjacent structures (e.g. palate, nasal cavity and dentition) throughout childhood growth.²⁶

The degree of ankyloglossia requiring intervention has not been well established. Messner¹⁶ reports a trend with severity and thickness with breastfeeding difficulties however concludes that there is no clear relationship between severity and feeding difficulties.¹⁶ Rather than classification-breastfeeding difficulties and pain are effective guides for when the procedure should be performed.²⁷

Recent systematic reviews by Webb *et al.*, 2013²⁸, Edmunds 2011¹⁰ and Power 2014¹² assessed the efficacy of frenectomy in alleviating breastfeeding problems. In particular studies by Berry *et al.* 2012²⁹; Buryk *et al.* 2011³⁰; Dollberg *et al.* 2014³¹; Emond *et al.* 2014³²; Hogan *et al.* 2005³³,

Griffiths 2004³⁴ and Geddes 2008⁶ all indicated that breast feeding difficulties and maternal pain scores reduce following lingual frenectomy.²⁸ O'Callahan *et al.* 2013 found that infants improved in their latching and were less likely to click or take in air while feeding following frenectomy.²¹ For mothers, both the presence and severity of nipple pain decreased from pre-to post-intervention^{11,23}. Outcomes assessed in these papers were both objective (latch scores, pain scores, infant weight gain) and subjective improvement in feeds.

However, the release itself is not always sufficient for success in breastfeeding, with additional support from lactation consultants guiding the mother and infant essential in some situations.³⁵

The surgical approach requires the infant to be immobilized by careful wrapping. The frenulum is retracted with a grooved retractor and separated with sterile scissors, usually without anaesthetic.¹⁰ Lasers have been used to treat older children and adults, with a few reports also in infants.²⁰ The infant is encouraged to feed immediately following the procedure, assisting with extension of the tongue and achieving haemostasis. The breast milk functions as both an analgesic and antiseptic as well.²²

As complications are quite rare, the procedure is considered both safe and effective. Possible complications include haemorrhage, infection and salivary gland injury.²² 2% of infants develop an ulcer under the tongue and 2.6% require a repeat procedure.^{11,12}

Despite the successful outcomes, there is no accepted method of release or specified clinician to provide treatment. The right amount of tissue release is required to provide effective results and incorrect management can result in scarring (or thermal injury from lasers) which can increase the tethering effect.⁵

Ankyloglossia can impact further upon feeding by altering the shape of the hard palate. The palate, which forms from fusion of palatal shelves at the midline in the embryo, is normally shaped into a "U" shape by pressure from the tongue during swallowing. Where the tongue has been unable to contact the palate sufficiently the palate may become high arched.³ As the palate must be filled in order to stimulate the suck reflex, a high arched palate may result in increased intake of air with nursing, increased need for the tongue to rise during swallow (and to change pressure gradients) or failure to stimulate the suck reflex.³

It is discussed that with regards to feeding, the jaw and the tongue are closely linked. A significantly retrognathic jaw may place the tongue in a retruded position and despite normal attachment, the infant may be unable to lift the tongue to reach the palate, or there may be difficulty in nursing as the base of the tongue is tethered by the jaw.⁵ Dhal, 2015³ discusses that where independent movement of the tongue, jaw, and palate does not occur, difficulties arise in feeding and surgical management to allow for independent movement of these structures is indicated.

It has been proposed that the attachment point of the maxillary labial frenum ("Lip tie") can impact on the baby's ability to flare the lip and thus limit the formation of an effective seal around the nipple for feeding.^{36,37}

The Maxillary labial frenulum in a newborn can be classified according to Kotlow's classification (2011)¹⁸ from Class I (attaching higher on the alveolus) to IV (attachment extending interpapillary to the hard palate). They can vary from thin to a wide-based (fan like) attachment.⁸ Other classifications for labial frenula use the teeth for reference points and thus are not relevant in the new born. A low attachment point is often seen at birth, (Flinck 38 reporting 76% of new borns have a grade 3 attachment and Ghaheri²⁰ presenting similar figures) and with alveolar growth the attachment point usually regresses in height.^{23,39}

There are no well-structured studies at present investigating the effect of "Lip tie" on breast-feeding. The potential interference was first reported by Weissinger and Miller in 1995 in a case report³⁶ describing release of the maxillary labial frenulum resulting in a better latch and feeding in a child with breastfeeding difficulties. Descriptions of an effective latch for breastfeeding theoretically concur that without flanging of the upper lip, the lips remain pursed, not covering the areola effectively for a seal and/or latch.³ A poor latch results in the use of the gingival pads over the teat, resulting in pain, damage to the nipples, ineffective feeding³ and swallowing of air.²⁰

Kotlow reports specifically babies with a class III or IV could have a limited ability to flange their lips and thus recommends treatment in these cases.⁴⁰ The use of an Erbium:YAG laser (with or without local anaesthesia) to release the maxillary labial frenulum has been reported.^{20,41} Post-operatively it has been suggested to pull on the lips twice daily to help separate

the lip from the gingival tissues. Pransky²³ reports retrospectively on 14 babies who underwent lip tie release, all had improved breastfeeding outcomes (improved weight gain and latch with reduced nipple pain and mastitis). Through case reports Kotlow has also reported an improved ability to feed following release, minimal intra-operative difficulties and uneventful healing.³⁷

There are no current studies directly exploring the relationship between poor nursing efficacy and the risk of early childhood caries (ECC) however conclusions could be drawn from an understanding of the etiology of the caries process. ECC is defined as the occurrence of dental caries before the age of six.⁴² Ripa, 1988⁴³ describes the lesions seen in ECC are modulated by a few factors including the duration of the deleterious habit and the muscular pattern of infant sucking.

Prolonged feeding time is often suggestive of poor nursing efficacy, Wallace and Clarke, 2006¹¹ describe children with feeding difficulties tend to feed for longer and/or have a continual feeding cycle.¹¹ Miranda⁴⁴ reports children with ankyloglossia feed more frequently pre-frenectomy than following the frenectomy procedure. This is supported by Geddes⁶ who shows that there is an increase in milk transfer rate and Khoo *et al*⁴⁵ who describe a reduction in feed length and increase in time between feeds following tongue-tie release. Thus, infants with feeding difficulties can be considered at an increased risk of ECC as both frequency and time of exposure (length) to feeding has been implicated in caries progression.^{43,46} Some authors have described that children with nursing caries practiced a nursing habit 8.3 hr/day compared to only 2.2 hr/day for children without nursing caries.⁴³ This implies that difficulties with feeding may potentially increase the risk of ECC.

In addition to this, infants with difficulty feeding are more likely to be formula fed, with one study reporting that 7/10 children with feeding difficulties were supplementing feeds¹¹ and another describing that children with tongue-tie were three times more likely to be bottle fed at one week.⁷ Bottle or supplemental feeding is often done with formula, which influences growth of different oral microbiota to infants that are breastfed.⁴⁷ For breast-fed infants the acquisition of strep mutans is delayed and there are more health associated bacteria compared to

formula fed,⁴⁷ increasing the risk of ECC in children who are not breastfed.

Furthermore, when infants have been feeding poorly there is an element of 'catch up' in nutritional intake required to regain expected weight, possibly requiring a greater volume of formula and higher frequency of feeds, again increasing the risk of ECC.

Conversely, it can also be argued that human milk has a higher cariogenic potential than bovine milk (used in formula) due to increased levels of lactose⁴³. Thus when considering oral flora acquisition and substrate composition it is unclear if formula feeding in infants, with a history of poor breastfeeding habits, leaves these children at a higher risk of ECC.

The pattern of ECC may vary with anatomical variation. The muscular pattern of sucking comes into play as limited movement of the oral tissues results in reduced clearance of the oral cavity^{48,49} and stagnation of substrate has been linked to caries.⁵⁰ Additionally, during breastfeeding the lower incisors are usually protected with the extension of the tongue covering this region⁴³, however a child with ankyloglossia is unable to extend the tongue in such a fashion, leaving these surfaces exposed to the substrate.

Kotlow⁴¹ reports that an abnormal maxillary frenulum attachment can contribute to labial caries or carious notching of incisal edges in infants, due to the retention of milk adjacent the frenulum following feeding. A class III or IV frenulum is described to be a risk factor even for children with no history of nocturnal or prolonged feeding, as it can form a pocket that retains the substrate at the tooth surface following feeds.⁴¹ The thick fibrous attachment is also understood to limit the normal mobility of the upper lip, resulting in stagnation. It is described that mesial decalcification occurs as the resultant diastema is difficult to clean, creating an ecological niche.⁴¹ The authors views, however are not supported by a high level of evidence in the existing literature.

It is well documented that oral musculature has an impact upon a child's ability to breastfeed. Release of ankyloglossia has shown to be effective and safe, however well constructed trials regarding the contribution of lip ties to feeding difficulties are required. At present, there is no consensus amongst practitioners worldwide regarding intervention for lip and tongue-ties. Additionally, a

lack of agreement in the literature on classifications, when and who should be providing the surgical intervention, may contribute to the uncertainty regarding management. There is no current evidence in the literature on the contribution of these two frenula to the development of ECC- either directly through reduced oral clearance or indirectly through frequency and the length of feeds. Considering the increasing prevalence of ECC, the potential contribution of the oral anatomy warrants further investigation, as modifying this factor early in life is possible, with potential life long benefits.

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Louise Brearley Messer ANZSPD Undergraduate Essay Competition 2016

Discuss the amount of fluoride contained in the toothpastes in widespread use for children in Australia and New Zealand. What are the differences in the minimum fluoride concentrations of these toothpastes between the two countries for different age groups and how have these changed over time? What are considered to be the net benefits in increasing fluoride concentration in toothpaste used for younger children?

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Abstract

Dental caries is a global health concern. Studies have shown that fluoride is capable of reducing the incidence of dental caries. In both New Zealand and Australia, the main difference is in the minimum recommendations for toothpaste use amongst children under the age of six years. However, the question still remains as to whether there is a consensus regarding any benefits from increasing fluoride concentration in fluoridated toothpaste. This systematic review aimed to determine whether increasing fluoride concentration in fluoridated toothpaste has a net benefit in preventing dental caries. Database search was conducted in August 2016 in accordance with the PRISMA guidelines to find published studies on the use of fluoridated toothpaste in young children under the age of 6 years. Seven studies were deemed suitable. Two studies concluded that there was statistically less decayed, missing, and filled teeth (DMFT) in the intervention group with higher concentration of fluoride ($p<0.02$). The results of the remaining five studies showed no statistical difference in both DMFT and decayed, missing, and filled surfaces (DMFS) ($p>0.05$). However, the studies were rated as being of both moderate ($n=1$) and high ($n=6$) risk bias. Fluoridated toothpaste has a net benefit for controlling dental caries in young children. Despite the inconsistent results provided of whether to increase the fluoride concentration, it should not be completely dismissed due to the numerous confounding factors. Therefore, it should be the discretion of the practising dentist to weight the benefits and risks before a clinical decision is made.

Key words: Australasia, dental caries, fluoride, toothpaste, young children

Introduction

Dental caries is a global health concern. According to the World Health Organisation, 60-90% of school children have a dental cavity.¹ A report conducted by the Australian Institute of Health and Welfare (AIHW), found that 48.2-56.6% of children between 5-6 years of age had either decayed, missing or filled teeth.² In a recent population based-study conducted by the Australian Research Centre for Population Oral Health, titled 'National Child Oral Health Survey 2012-2014', out of 24,000 children aged between 5-14 years, greater than 40% of children aged 5-10 years had dental caries in the primary tooth and one in four children had untreated dental caries.³ Numerous studies have shown that fluoride is capable of reducing the incidence of dental caries, as well as having a reversible effect on the progression of the existing lesions.^{4,5}

According to a Cochrane Review published by Marinho *et al.* (2003), out

of 70 studies that were included, children who brushed their teeth once a day with fluoride toothpaste showed a statistically significant decrease in dental caries as quantified by decayed, missing and filled tooth surfaces (DMFS) ($p<0.0001$). In addition, greater fluoride concentration as well as increased frequency of brushing conferred further benefits in treatment outcome ($p=0.03$; $p<0.0001$).⁶

Based on the Cochrane review stated above, this essay will gather all the necessary evidence outlining the varying concentrations of fluoride in toothpaste in both Australia and New Zealand, including variability in minimum fluoride concentrations now and before, as well as systematically reviewing the benefits of increasing fluoride in younger children.

Available formulation and its compliance

Toothpastes available in Australia formed as junior formulation (400-550 parts

per million [ppm] fluoride), standard formulation (1000-1500 ppm fluoride) and high caries risk (5000 ppm fluoride).⁷ Quantitatively, 1000 ppm of fluoride is equivalent to 0.22% sodium fluoride or 0.76% sodium monofluorophosphate. In New Zealand, different ranges of toothpaste are available: full-strength, age-specific, and naturopathic.⁸ It is important to note that most fluoridated toothpastes in retail contain 1000 ppm fluoride and 400-550 ppm fluoride for children under the age of six years.^{9,10} Colgate markets abrasives for removing plaque and stains, as well as polishing teeth. Such abrasive agents range from 5-50%. The most common ones are silica.¹¹ The common measurement of abrasiveness of each available abrasive agent is called relative dentine abrasivity.¹² The acceptable standard is below 250, as greater value may confound the remineralisation rate.¹¹

Despite the varying ranges of formulation, compliance is a problem in both Australia

as well as New Zealand. The report published in 2012 by AIHW outlines the dental health behaviours among children in the timeframe of 2002-2004. 67.0-72.2% of children aged 5-6 years have been reported to brush their teeth at least twice a day, 32.0-41.3% of children aged 5-6 years have been reported to utilise standard toothpaste and 57.0-66.9% of children aged 5-6 years have been reported to utilise children's toothpaste.¹³ Despite the recommendation provided, according to the New Zealand Oral Health Survey conducted in 2009 by the Ministry of Health, only 15.3% of children ranging from 2-4 years of age brushed twice daily using fluoridated toothpaste with greater than 1000 ppm of fluoride.¹⁴ Furthermore, a study published by Li *et al.* (2016) that consisted of an online sample completed by parents and caregivers of pre-schoolers ranging in age from four months to four years (n=1056), determined the use of full-strength fluoride toothpaste. The authors concluded that only 19% of the pre-schoolers utilised the 1000 ppm fluoride toothpaste. It was further explained that the reasoning behind this was due to a lack of information on fluoride use as only 15.7% and 4.2% of parents or caregivers chose toothpaste based on low to no fluoride, respectively.⁸

History of fluoride toothpaste now and then

In 1914, fluoride toothpastes were first introduced to the public to help target dental caries.¹⁵ In 1950, fluoride was added to the Colgate formulation with an approval from the American Dental Association Council on Dental Therapeutics (1960).¹¹ Table 1 outlines the history of the minimum fluoride recommendations throughout Australia and New Zealand.

From the period of 1960-1970, Australia benefited from fluoride through both water fluoridation and toothpastes. However, more research emphasis was placed on ways to reduce dental fluorosis in 1989 due to the increased prevalence.¹⁶ In the 1990s, there was an active progression towards introducing low-fluoride children's toothpaste as well as providing advice to parents on how to encourage their children to brush their teeth. The rationale behind this was to prevent ingestion of fluoridated toothpaste, minimising the potential risk of dental fluorosis. According to the Consensus Conference of the Appropriate Fluoride Exposure

for Infants and Children in 1993, for children under 6 years of age, small amount of fluoridated toothpaste was encouraged to spit out during and after brushing.¹⁷ However, the Australian Institute of Health and Welfare (AIHW) reported that from 1993 to 2000, there was a reduction in tooth brushing frequency as well as an increase in the use of low strength fluoride. Despite the reduction of mild fluorosis risk, the caries-protective effect of fluoride most likely would have been compromised.¹⁸ In 2006, Australia published its guideline on fluoride use in the Australian Dental Journal after hosting a workshop in 2005. The guideline states that the minimum concentration of fluoride is age dependent. From the age 18 months to 5 years the toothpaste should be dispensed in a small pea-sized amount on a child-sized soft toothbrush. The only exception to the guideline is when the child is not consuming fluoridated water or is of a high carious risk and according to the discretion of a dental professional.¹⁹ In 2012, a fluoride consensus workshop was conducted to review the guideline formed in 2005 (published in 2006) and the necessary amendments were made.²⁰

Following the introduction of water fluoridation in 1954, the first fluoridated toothpaste was introduced in 1960 to 1970. During this decade, the sales of fluoridated toothpaste in New Zealand increased from 10 to 75%.²¹ The New Zealand Guidelines for the Use of Fluorides was formulated after utilising the Australian consensus guidelines as a baseline.¹⁹ It was proposed that toothpaste labelled 'child strength' is to be avoided. However, it was further explained that only a smear of toothpaste (5mm on a small brush) is to be utilised in children under 5 years old and pea size amount from 6 years onwards.¹⁰

In both New Zealand and Australia, the main difference lies in the minimum recommendations for toothpaste use amongst children under the age of six years.²² Nevertheless, it is important to emphasise that the frequency of tooth brushing in both New Zealand and Australia has been recommended to be twice daily.^{10,19}

Question of interest

Based on the historical studies available, fluoride has had beneficial effects in preventing dental caries. However, due to discrepancies surrounding the concentration of fluoridated toothpaste, the question is raised as to whether there is documented evidence determining whether increased levels of fluoride in existing fluoridated toothpaste has a net increase in benefits. Therefore, a systematic review needs to be conducted in order to determine whether an increase in fluoride concentration in fluoridated toothpaste is beneficial.

Collection of evidence

A systematic review was conducted according to the PRISMA statement for systematic reviews.²³ The search was conducted in August 2016. This included prospective human clinical trials for children under the age of 6 years. No limits were placed in terms of the language of publication and time which the studies were published. Literature searches covered the PubMed, Embase, and Medline databases. Reference lists from studies were also utilised to find additional suitable studies to be included in the review. All studies were screened using their titles and abstracts, and excluded if they did not fulfil the inclusion criteria. This left seven studies meeting the criteria and being suitable for inclusion in this systematic review.

Table 1. Minimum fluoride recommendations throughout Australian and New Zealand history

Australia		New Zealand	
1960-1970 ¹⁶	Introduction of fluoridated toothpaste	1960-1970 ²¹	Introduction of fluoridated toothpaste
1993 ^{18,37}	24 months – 7 years: 400-550 ppm	–	
2006 ¹⁹	0-17 months: No fluoride 18 months-5 years: • Low caries risk: 400-550 ppm • High caries risk: >1000 ppm > 6 years: 1000 ppm	2006 ¹⁹	Adopted similar guidelines as Australia until 2009
		2009 ¹⁰	All ages >1000 ppm
2012 ²⁰	0-17 months: No fluoride 18 months-5 years: • Low caries risk: 400-550 ppm • High caries risk: >1000 ppm > 6 years: 1000-1500 ppm		

ppm – parts per million of fluoride.

Table 2. An overview of the studies reviewed

Another (Year)	Subjects (Follow-up time)	Intervention (F agent & abrasive)	Comparative treatment (F agent & abrasive)	Outcome	Degree of bias
Clasen <i>et al.</i> (1995) ³⁸	172 (22 months)	1450 ppm NaF / Silica	250 ppm NaF / silica	NaF / silica No statistically significant difference in DMFT or DMFS ($p=0.30$; $p=0.18$)	High risk of bias • Low population number • Inadequate reliability • Unclear random allocation • Inadequate concealing of allocation • Uncertain baseline balance
Davies <i>et al.</i> (2002) ²⁴	3,731 (48-60 months)	1450 ppm 23% NaF + 69% SMFP / dicalcium phosphate dihydrate	440 ppm NaF / silica	Statistically less DMFT in the intervention group ($p=0.02$)	Moderate risk of bias • Dropout rate >20% • Possible selective outcome reporting • Questionable reliability • Uncertain about contaminated data • Uncertain baseline balance
Ellwood <i>et al.</i> (2004) ²⁵	3467 (7 months)	1450 ppm	40 ppm	Statistically less DMFT in the intervention group ($p<0.002$)	High risk of bias • Unclear random allocation • No concealing of allocation • Uncertain baseline balance
Gerdin. (1974) ³⁹	213	1000 ppm NaF / -	250 ppm KF / -	No statistically significant difference in DMFT or DMFS ($p=0.51$; $p=0.39$)	High risk of bias • Not enough sequence generation • No concealing of allocation • Incomplete outcome data not addressed • Selective outcome reporting • Questionable reliability • Uncertain about contaminated data • Uncertain baseline balance
Lima <i>et al.</i> (2008) ⁴⁰	43 (12 months)	1100 ppm NaF / Silica	500 ppm NaF / Silica	No statistically significant difference in DMFT or DMFS ($p=0.51$; $p=0.39$)	High risk of bias • Low population number • Dropout rate >20%
Vilhena <i>et al.</i> (2010) ⁴¹	529 (20 months)	1100 ppm NaF / -	550 ppm NaF / -	No statistically significant difference in DMFS ($p>0.05$)	High risk of bias • Dropout rate >20% • Possible selective outcome reporting • No concealing of allocation • Uncertain baseline balance
Winter <i>et al.</i> (1989) ⁴²	2177 (36 months)	1055 ppm SMFP / calcium glycerophosphate	550 NaF + SMFP / calcium glycerophosphate	No statistically significant difference in DMFT or DMFS ($p=0.09$; $p=0.296$)	High risk of bias • Dropout rate >20% • Not adequate reliability • Inadequate concealing of allocation • Incomplete outcome data not addressed • Uncertain baseline balance

KF: Potassium fluoride / NaF: Sodium fluoride / ppm: parts per million of fluoride / SMFP: Sodium monofluorophosphate

Data extraction was undertaken after analysing the methodologies and results provided in the studies of interest. Primary outcomes were based on decayed, missing, and filled teeth (DMFT) or decayed, missing, and filled surfaces (DMFS). Quality assessments of the studies were undertaken, and each study was categorised as having low, moderate, or high risk of bias. In order to provide higher review power, the methodologies in each study were analysed for similarities.

Net benefits in increasing fluoride concentration in toothpaste used for younger children

Due to the comparative nature of this systematic review, the results have been presented in accordance with the Population, Intervention, Comparative, and Outcome (PICO) criteria (Table 2).

The assessed level of bias is stated for each paper in this table. The studies were assessed as having one moderate and five high risk of bias. The studies published by Davies *et al.* (2002) and Ellwood *et al.* (2004), concluded that there was statistically less DMFT in the intervention group with higher concentration of fluoride ($p=0.02$; $p<0.002$). However, the remaining five studies showed no statistical difference in both DMFT and DMFS.^{24,25}

Is the evidence justifiable?

Due to the inconclusive results, it is important to analyse all the evidence collected. Rasines (2010)²⁶ commented based on the Cochrane Review published by Walsh *et al.* (2010).²⁷ Both authors supported the use of greater than 1000 ppm of fluoridated toothpaste in children

and adolescents. Furthermore, Wong *et al.* (2011) undertook a network meta-analysis by analysing direct and indirect randomised controlled trials of different concentration of fluoride in fluoridated toothpaste. In addition, results from experimental and observational studies had been collected to determine the risk of fluorosis. The results outlined that anti-caries benefits were shown to be significant at a fluoride concentration of 1000 ppm and above in comparison to the placebo ($p<0.05$). Despite the potential increased risk of fluorosis in children under the age of 12 months was minimal. The authors commented that the concentration of fluoride in toothpaste for those less than six years age should only be dependent on the caries risk and potential mild fluorosis risk.²⁸ Therefore, for use under the age

of six years it was advised this be done based on weighing the risk of fluorosis to benefits.^{26,27} Furthermore, a meta-analysis conducted by dos Santos *et al.* (2013) consisting of eight quasi-randomised and randomised clinical studies of preschool level children concluded that brushing with fluoridated toothpaste resulted in a significant reduction in dental caries in the primary dentition ($p<0.05$).²⁹ Whether the concentration of fluoride in the toothpaste had any impact on the caries incidence was published in the systematic review conducted by Wright *et al.* (2014). The authors concluded that there was limited evidence to suggest any benefit from increasing the fluoride concentration. However, the limitation of the study is that all of the studies included in the systematic review consistently had a high risk of bias.³⁰ Furthermore, water fluoridation in different geographic areas within Australia and internationally, abrasive agents, seasonal changes, and socioeconomic differences, can have a confounding impact on whether low or high concentrations of fluoride in fluoridated toothpaste are beneficial or not.³¹⁻³³

Regardless of the conflicting evidence as shown in this systematic review, as well as other published studies, it is important to determine the factors which may confound the results. The variations of what is defined as a pea-sized amount is confounded by geographic areas, the type of toothbrush used, and the parent's perception of what is defined as pea-sized. However, it is important to determine that the ideal size has been considered to be 0.25g.³⁴ This is to avoid any overuse and minimise possible risks of fluorosis. Nevertheless, in order to utilise the fluoride effectively within fluoridated toothpaste, it has been suggested by numerous studies to keep mouth rinsing with water after brushing to an absolute minimum.^{29,35} To further emphasise the quantity of toothpaste used, in a recent double-blind, randomised, six-arm crossover study conducted by Nazzal *et al.* (2016), it was reported that time spent brushing, toothpaste fluoride concentration, and rinsing, had a significant impact on the residual fluoride concentration ($p<0.001$). However, there was no effect on the presence of caries ($p>0.05$). From a clinical aspect, the authors concluded that children with high caries risk would benefit most from fluoridated toothpaste of greater than 1000 ppm fluoride, in addition to spitting out the excess but not rinsing after brushing.³⁶

Conclusion

Both New Zealand and Australia have similar goals in terms of optimising oral health care and decreasing dental caries, however the fluoride concentration recommendation in fluoridated toothpaste is varied in children under the age of six years. Despite the inconclusive results provided in this systematic review, it is important to conclude that fluoridated toothpaste does have a net benefit for control of dental caries in young children. Whether to increase the concentration of fluoride in fluoridated toothpastes should not be completely dismissed at this point in time. Furthermore, it is imperative to note that the risk of mild fluorosis is very low and that potential benefits need to be considered, in addition to confounding factors such as type of abrasive agents, compliance, fluoride retention rate, caries risk, geographic changes, seasonal changes, and socioeconomic differences. As a practising dentist, it is prudent to assess appropriate fluoride levels holistically rather than quantitatively.

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BRANCH REPORTS

QUEENSLAND BRANCH REPORT

by Greg Ooi



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WE LOOK FORWARD TO WELCOMING YOU TO THE GOLD COAST AND SEEING YOU AT ANZSPD 2018



The Queensland branch of the Australian and New Zealand Society of Paediatric Dentistry (ANZSPD) warmly extend an invitation to members and colleagues, to attend the 19th Biennial Congress to be held at Seaworld on the Gold Coast, Australia. 'Fissures and Seals' will run over 4 days from 15-18 February 2018.

While beginning on a preventive theme, the congress will present current developments and findings on various aspects of Paediatric dentistry. Areas of interest such as interceptive orthodontics, minimal intervention, dysphagia, cariology, traumatology and prosthetics, will be presented by both renown international and local speakers.

The scientific program will be accompanied by exciting social events to provide the opportunity for social intercourse with past and new friends, not to mention the access to Seaworld and sister theme parks included with the onsite accommodation – ideal for accompanying families!

In preparation for the event, the Gold Coast has undergone extensive improvements and upgrades in infrastructure and facilities to provide a welcoming and unsurpassed experience solely for you, our valued delegates (honest!).



Dr Hannah Burns



Dr Julie Chichero



Dr Kathryn Elsworthy



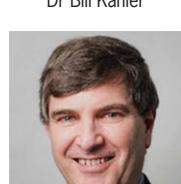
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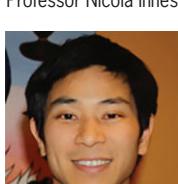
Professor Nicola Innes



Dr Mike Foley



Professor Ian Meyers



Dr Desmond Ong



Mark Robertson



Federal President's Report

Tim Johnston

I wish you all a safe holiday season. It is 46 sleeps (at the time of writing) until the 'Big Guy' visits, but tomorrow, go to work, engage with your patients and enjoy listening to their dreams, hopes and wishes. I bet they're not far off yours.

Nearly another year has flown by. Not many sleeps until the big guy in the Red suit tries to get down my chimney again. Unfortunately, I do not have a real chimney which probably explains the very small number of boxes I get in my stocking and certainly the very low percentage of wishes that match my Santa list I send off months before. After being just 800 nautical miles south of the North Pole last year and seeing the drastic lack of sea ice, it became very clear the real importance of ensuring all my mail to Santa goes early while there is ice to walk on.

I do love this time of the year at work, we have been counting down sleeps until Christmas for about two months now. Mums hate it, kids love it and it opens such a wealth of conversation topics. And yes, I hear some of you, yes we do live in vibrant multicultural countries where religious beliefs thankfully are allowed to flourish without discrimination and not all cultures indulge in yuletide, but thank goodness we deal with kids. They can see through the correctness and socio-political rubbish, heck they see though a heap of my carefully honed behavior management techniques, because kids see what is real or at least what is real to them. So rock on kids, rock on Multicultural Santa and lets really enjoy listening to the dreams, hopes and wishes of our little patients.

And with dreams and wishes we hope our federal politicians have the clarity of thought that out little patients do. One of the presidential duties of the last year was to prepare a submission to the ADA to be part of their submission to the Senate Community Affairs References Committee Private Health Insurance Inquiry and a second submitted directly to the inquiry. Much of the concern raised by ANZSPD unfortunately falls outside the terms of reference however I and those advising felt it was important that all concerns and comments were raised, even if not considered. The Inquiry has had a public hearing and only two dental organisations were invited to present, one being the Australian Dental Association and the other our sister organization the Australasian

Academy of Paediatric Dentistry. I would like to congratulate the AAPD Executive and those involved in the presentation for their extraordinary recognition and thank them for promoting the provisional of oral health care to our youngest citizens.

Fortnightly, if not more frequently an email arrives from the ADA seeking comment or input to different national board enquiries, other government enquiries or policy development in the health care industry but not limited to the provision of care. Some of the reports are forty plus pages long and take a bit of time to sit down and go though, then reply to. It is a privelge though to have such an open view to the national health and occupational health industry and the very active role the Australian Dental Association plays. I am not privy to a similar level of access from the New Zealand Dental Association but trust they are as active. In a world where we are seeing big business including the Private Health Industry encroaching on our profession and in fact, question if Dentistry will remain a profession for much longer or simply become another skilled vocation, it is encouraging to see such diligent leadership and advocacy that we have.

ANZSPD is an affiliated body of the Australian and New Zealand Dental Associations. It is very important to the Society to have this professional connection so that we can gain advice and support where needed but in return, ANZSPD has a voice within the Dental Associations where decisions of policy and governance has direct affect on our daily professional lives. ANZSPD Federal is undergoing a re-write of our constitution under the stewardship of John Sheahan as Chair of the Constitution subcommittee and obviously an important part is to ensure the membership By-Laws are contemporary but adhere to the ADA's requirements. From my understanding, affiliation has not been a concern with NZDA.

Not one branch of ANZSPD has a membership category list that mirrors another. With such variation, there is very real potential that ANZSPD could

fall foul of the ADA affiliation By Laws. Being aware of this I encourage all branch executives to revisit their membership and judge in accordance with the current constitution and By Laws. And yes again I hear those who raise voices, I have heard a number of times the requirements of membership and ADA affiliation may be in breach of the ACCC rules, but they requirements are dictated by the ADA so I will let them fight that one!

I am currently assisting one ANZSPD Branch to seek approval for the federal ADA to allow two very active friends of ANZSPD, but importantly active participants in the clinical and academic dental community as a whole to become full members of ANZSPD. The ADA does allow for this provision and I personally consider this is within the spirit of ANZSPD if such allied medical professional's values reflect the objectives of ANZSPD as outlined in our present and future Constitution.

With the new Constitution being prepared with the aim of presenting it to the membership in early 2018, I ask if anyone reading this has thoughts, opinion or concerns with the current constitution then please be in touch with the Federal Executive. A copy of the current constitution is available through the website.

The remainder of the year will be busy, but we have the 19th Biennial ANZSPD Congress being held at Seaworld on the Gold Coast to look forward to. I would like to take the opportunity of acknowledging Greg Ooi and his committee's tireless work in organising what looks to be a varied and stimulating program that will appeal to everybody and their individual interests. Please go to the ANZSPD 2018 website and register, it's open.

Finally, a thank you to Steve, the Editor of Synopses. Being a past editor I am acutely aware of the effort that is put in to publishing this journal. Synopses is an important resource document for the dental community and I thank, on behalf of the Society, all those who contribute and of course the undying support of Colgate.

WESTERN AUSTRALIA

by Vanessa William



Lars Andersson presenting at the University Club UWA



The Scientific Meeting held at the University Club UWA



Three of our speakers at Bunker Bay: Dr Steve Singer; Dr Janina Christoforou, Dr Glen Liddelow



Postgraduate Seminar with Lars Andersson

Western Australia has enjoyed another successful year, culminating in our Scientific Meeting, Managing the Complications following Traumatic Dental Injuries, with Keynote speaker Professor Lars Andersson. With 170 attendees, the event was enjoyed by everyone.

Professor Andersson was also generous with his time providing a half day seminar on Avulsions and Root Fractures for the postgraduate students. He was impressed by the number of students and interest from various disciplines, namely Paediatric Dentistry, Endodontics, Oral and Maxillofacial Surgery and Oral Medicine.

On the University front, we welcome two new Paediatric Dentistry Registrars who commenced their speciality training in July 2017: Drs Vanessa Cho and Anna Buckeridge.

Our Senior Paediatric Dental Registrars recently presented their research at IAPD Chile 2017

- Dr Jilen Patel: Tooth mineral density of teeth with Amelogenesis Imperfектa – A Micro-CT study
- Dr Lisa Bowdin: Biodentine – Leachate Analysis in Artificial Saliva with Differing pH
- Dr Gregory Celine: Use of eye-tracking technology in dentistry
- Dr Nandika Manchanda: E's or 6's which teeth are missing: An unusual case of Oligodontia

The Paediatric Oral Health Research Group has also been successful in receiving a number of competitive research and clinical grants

- Dr Jilen Patel: The Wrigley Company Foundation ADAF Community Service Grant Project title: An Integrated, multi-disciplinary oral health education and prevention program for refugee children
- Dr Lisa Bowdin: ADAWA – Clinical Dentistry Grant Project title: Evaluation of Biodentine as a restorative material in primary teeth: In vitro study
- Dr Chaturi Neboda: ADAWA – Clinical Dentistry Grant Project title: Silver Diamine Fluoride in hypomineralised first permanent molars: In vitro study

A big congratulations to our hard working postgraduates! I am in awe of the work you are achieving! I would also like to thank Associate Professor Robert Anthonappa for being the driving force behind our postgraduate students and would also like to thank him for the articles he helped provide for this issue of Synopses.

Our AGM was held at Moore & Moore Café on Friday, 27th October. I would like to congratulate the incoming Branch Executive:

President: Dr Mark Foster

Vice President: Dr Rebecca Williams

Secretary: Dr Joy Huang

Treasurer: Dr Greg Celine

Federal Councillor: Dr Carmel Lloyd

The committee is now in the process of arranging fantastic programs for 2018 and the RK Hall Meeting in early 2019. Please keep a lookout for updates on the ANZSPD.org.au website.

As my two year term as President of the WA Branch comes to an end, I would like to thank my committee, with a special thanks to Drs Mark Foster and Rebecca Williams.

I'd also like to take this opportunity to wish everyone a wonderful festive season and would like to wish the new executive continued enjoyment and success.

SOUTH AUSTRALIA

Dr Gwendolyn Huang



Prof Lars Andersson



ANZSPD SA Branch Committee with guest Professor Geoff Heithersay and speakers, Professor Lars Andersson, Dr James Lucas and Dr Marie Reichstein

Another year has come and gone. Throughout the year, our meetings have been engaging and well attended. Our first meeting of the year was given by Dr Hsuen Lee, a leading child and adolescent psychiatrist.

Dr Lee discussed the prevalence, presentation and management of children with anxiety, and also discussed whether our children are becoming more anxious. Professor Kay Roberts-Thomas revised fluoride in May.

Our August meeting saw Dr David Wabnitz, paediatric otorhinolaryngologist, discussed tonsils, adenoids, snoring and sleep apnoea in children. The last dinner meeting of the year involved Dr Sarah Constantine, radiologist, discuss radiographic presentations of oral and maxillofacial cysts and tumours in paediatric patients.

This year, ANZSPD SA Branch also organised a one and a half day seminar at the Adelaide Zoo with great success. The overall scientific theme was 'A Safari of Paediatric Dentistry', which represented the extensive variety that the field of Paediatric Dentistry entails.

Our keynote speaker, Professor Lars Andersson (oral and maxillofacial surgeon, Sweden) updated on current developments and treatment advancements of traumatic oral injuries with a specific emphasis on clinical application. Dr James Lucas (paediatric dentist, Melbourne) discussed the advantages, disadvantages, indications, contraindications of aesthetic crowns and how to use them, and also discussed the difficulties of management with children with salivary dysfunction.

A multi-disciplinary approach to the identification of tongue ties and anterior lip ties and how to manage these appropriately was presented by Associate Professor Sam Gue (paediatric dentist), Dr Thu Kent (paediatrician and Ms Kate King (speech pathologist). This presentation was extremely informative and clinically applicable. Associate Professor Gue also teamed up with endodontist, Associate Professor Giampiero Rossi-Fedele, and orthodontist, Dr Marie Reichstein, to give a multi-disciplinary perspectives of the management of enamel defects on first permanent molars, particularly discussing short and longer term options.

Dr Michael Malandris (paediatric dentist) and Ms Jenny Carney (dietitian) provided an insightful appreciation of the role of biofilm in diet and its contribution to dental caries.

I would like to thank the SA Branch committee for their continuous dedication and support.



Program

Thursday 15 February 2018

1900 – 2100	Welcome Reception with the Dolphins, Dolphin Plaza, Sea World
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Friday 16 February 2018

0800 – 0900	Opening Session
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0900 – 1015	<i>Plenary Lecture</i> Professor Nicola Innes <ul style="list-style-type: none">• "Minimally invasive children's dentistry with maximum success!"• "Recognition of the program (looking but not seeing)"• "Behaviour change to improve children's oral health (what actually works and how to do it)"
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0915 - 0945	Dr Kathryn Elsworthy Update on the SE Qld ECC project
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0945 - 1045	Dr Raahib Dudhia Low exposure 3D dental imaging vs traditional 2D imaging
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1115 - 1215	Dr Bill Kahler Update on splinting following dental trauma
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1315 - 1430	Professor Ian Meyers Tooth replacement with adhesive bridges
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1500 - 1730	Postgrad research presentations
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1900 - 2300	ANZSPD Gala Dinner in the Plaza, The Plaza, Sea World
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Saturday 18 February 2018

0900 - 1030	<i>Plenary Lecture</i> Professor Nicola Innes <ul style="list-style-type: none">• Hall technique• Silver diamine fluoride
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1100 - 1200	Dr Desmond Ong Autotransplantation: Appropriate dental recycling
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1200 - 1300	Dr Michael Foley Fluoridation: A watered-down account
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1300 - 1330	Closing Ceremony
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“Deep caries due to pre-eruptive intracoronal resorption in a newly erupted primary molar”: A critical appraisal

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Introduction

Case reports are defined as the scientific documentation of a single clinical observation and have a time-honored and rich tradition in medicine, dentistry, and scientific publication (Carey, 2010). Case reports are pertinent in advancing dental scientific knowledge especially of rare diseases and/or their management. In recent years, case reports have come under scrutiny and are frequently relegated to the lowest stage of the hierarchy of evidence-base medicine. Therefore, most international peer-review impact factor dental journals disfavor publishing case reports unless it is an exceptional condition or a novel management technique.

Most often, published scientific reports are taken at face value by the readers who do not thoroughly assess the articles. This may be due to (i) their busy schedules, (ii) lack of training to perform a critical appraisal, and/or (iii) assumption that the reviewer's and/or editors of journals would have enforced quality checks to the scientific content and presentation prior to publication. Therefore, we aim to critically appraise a case report that was recently published in the International Journal of Paediatric Dentistry, to

highlight some of the inconsistencies that may be evident post publication.

Critical Appraisal of the Case Report “Deep caries due to pre-eruptive intra-coronal resorption in a newly erupted primary molar” [Schwimmer et al. 2017]

Title

As discussed previously, it is not appropriate for the words “deep caries” to be used in the introduction as it is not relevant to this case. In addition, the word “pre” should not be capitalized in the middle of the sentence.

Introduction

There appears to be some confusion in the introduction, and throughout the article, regarding the terminology surrounding pre-eruptive intra-coronal resorption (PEIR). The first sentence of the introduction refers to “hidden caries”. As defined by Ricketts and colleagues (1997), hidden caries is “...a term used to describe occlusal dentine caries that is missed on a visual examination, but is large enough and demineralised enough to be

detected radiographically”. As the tooth 74 had recently erupted into the oral cavity, it is highly unlikely that the radiolucency was the result of the carious process. This interchangeable (mis)use of terminology namely ‘hidden caries’, ‘pre-eruptive intra-coronal resorption’, ‘occult caries’ and ‘fluoride bomb’ occurs frequently in this report and in the dental literature. The final sentence of the introduction, which is the statement of the aim of the case report, also incorrectly refers to “caries in a recently erupted first primary molar” and makes no reference to PEIR.

The authors of the case report state that there is only one previous case of PEIR affecting the mandibular second primary molars (Seow & Hackley’s, 1996). However, the article by Seow & Hackley references two other previous reports of PEIR in primary mandibular canines (Rankow et al. 1986, Holan et al. 1994), which would make this case the fourth described case of PEIR in a primary tooth. Nevertheless, it is still the first case described in a mandibular first primary molar and therefore a useful publication.

Case Report

A case report is a useful publication in that it allows the reader to learn about rare or

new conditions and/or treatments, and incorporate these useful findings into their own practice. However, to facilitate this the case report should provide enough details regarding the condition and/or the treatment. While the management of the mandibular first primary molar affected by PEIR appears successful, the case report does not provide specific information regarding the procedure. Although, it is impressive that the treatment was completed on a 14-month-old child under conscious sedation and local anaesthetic, there were no details regarding the sedation agents, non-pharmacological behavior management techniques etc.

Very little information was provided about the endodontic and restorative treatment performed on tooth 74. There were no details regarding the number of appointments, root canal treatment protocols used, and the type of restorative materials placed [Figure 3 (a)]. In Figure 3(b) the root canal filling material appears short, especially in the distal root and the text does also not explicitly state which root canal material was used to restore tooth 74. Similarly, in Figure 3(a) although a large occlusal restoration is evident one can only speculate this to be an amalgam restoration, which according to Hickel and co-workers (2005) has a mean annual failure rate of 7.6% compared with 4.3% for stainless steel crowns. Furthermore, the remaining tooth structure surrounding the amalgam restoration appears to be quite thin, which increases the risk of fracture and subsequent complications. As child is only 14-months-old and the tooth will need to be in the mouth until the child is 10-12 years of age (Logan and Kronfeld 1933), hence one could argue that a stainless steel crown would have been a more appropriate choice of restoration.

The case report is also lacking in detail regarding the specific timing of appointments. From the case report, it is impossible to judge what time had passed between the patient's initial presentation, being administered antibiotics, having a radiograph, and completion of the endodontic treatment. It is not clear whether the follow-up time of 7 months is from the initial presentation to the clinic, or following completion of the endodontic and restorative treatment. The periapical radiographs illustrated in Figure 2(b) and 3(b) are presented as the pre-treatment and 7-month post-treatment radiographs, respectively. However, if the eruption status and root development of tooth 75 is compared in these images, it is more

likely that at least 12 months have passed between these two images. The treatment follow-up time is relatively short for a case report publication, especially in the International Journal of Paediatric Dentistry; a longer-term follow-up would better illustrate the success or failure of the treatment provided.

Readers should assess all Figures and information provided, and decide for themselves whether the diagnosis given by the authors is justified. According to the authors, tooth 74 appeared intact and stable, with no defects detected clinically, as illustrated in Figure 1. However, on viewing Figure 1, tooth 74 appears to have a minor dens evaginatus and the enamel of the occlusal surface appears darker and yellower than the surrounding enamel. Therefore, the presence of a qualitative defect of the enamel or communication between the oral environment and the PEIR defect cannot be excluded. The authors also conclude that "the [radiolucency] was probably a result of necrotic pulp due to caries that ensued from pre-eruptive intracoronal resorption". This illustrates a basic misunderstanding of the carious and PEIR process and raises concerns on the interpretation and presentation of this case report.

Discussion

The discussion in this case report is very limited. One would expect that most of the discussion would focus on the possible differential diagnoses of the radiolucency and abscess, including breakdown of the evaginatus creating a communication with the pulp, or a localised developmental anomaly of the dentine. For example, Seow and Hackley (1996) included a histological discussion of the affected tooth in their report, which could have been included in the discussion of the present paper. However, the discussion section only reiterates information that was provided previously in the case report.

Conclusion

The "why is this case important" box states that this is the "only known documented case of occult caries in the first primary molar". The term 'occult' is an outdated term that was not been used in the main body of the article. As discussed previously, 'occult caries' is another phrase commonly confused with 'hidden caries'. This case report describes a tooth with PEIR, not with occult caries.

Take Home Message

Despite the limitations highlighted in

this critical appraisal, the published case report is useful to highlight PEIR as a possible differential diagnosis in recently erupted primary teeth presenting with abscesses.

We suggest that clinicians' should employ a systematic approach when reading radiographs, so as to identify defects such as PEIR and provide timely appropriate management to either limit or prevent the subsequent complications.

Furthermore, we suggest that Readers should be cautious when reading journal articles. A thorough assessment should be carried out using the information and images provided prior to implementing the concepts into clinical practice. This will ensure that the dental community does not perpetuate false or misleading information accidentally, or intentionally.

Although there are clear limitations to the methodology of case reports in determination of treatment and establishment of new tests, the observation of a single patient can add to our understanding of etiology, pathogenesis, natural history, and treatment of particularly rare diseases, and to the training of potential junior investigators.

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Research and Art:

The Fairy Croc Father spreads the message about oral health for Aboriginal children

Professor Linda Slack-Smith

The Oral Health Inequities Group at the UWA Dental School have undertaken research work in the Aboriginal community over a number of years trying to better understand perceptions, barriers and enablers to oral health for Aboriginal children.^{1,2} A key issue arising in these interviews was the need for information and culturally appropriate resources to promote oral health in the Aboriginal community. My colleague A/Prof Angela Durey suggested we laminate copies of some of the dental student posters promoting oral health to give to community groups as a thank you for participating in our interviews – in the spirit of reciprocity. This inspired a project working with Aboriginal colleagues and artists to develop a series of posters promoting oral health. The characters were based on the cartoon character Gary Goanna developed by Diabetes WA for the Aboriginal community to prevent diabetes. The posters included new oral health characters such as the Fairy Croc Father and Emu Dentist who promoted oral health.

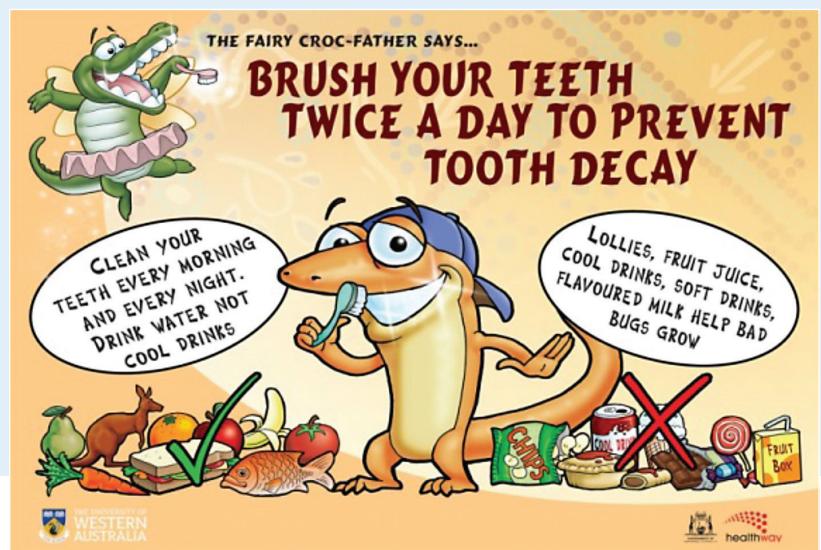
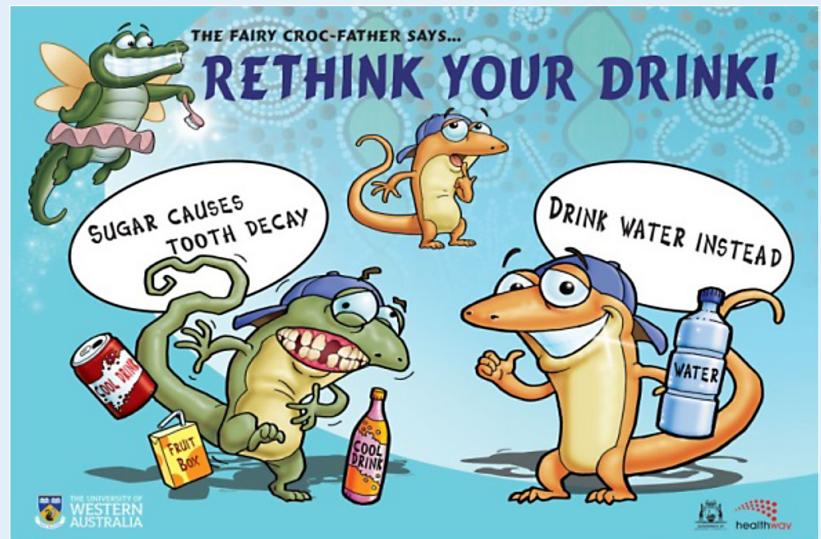
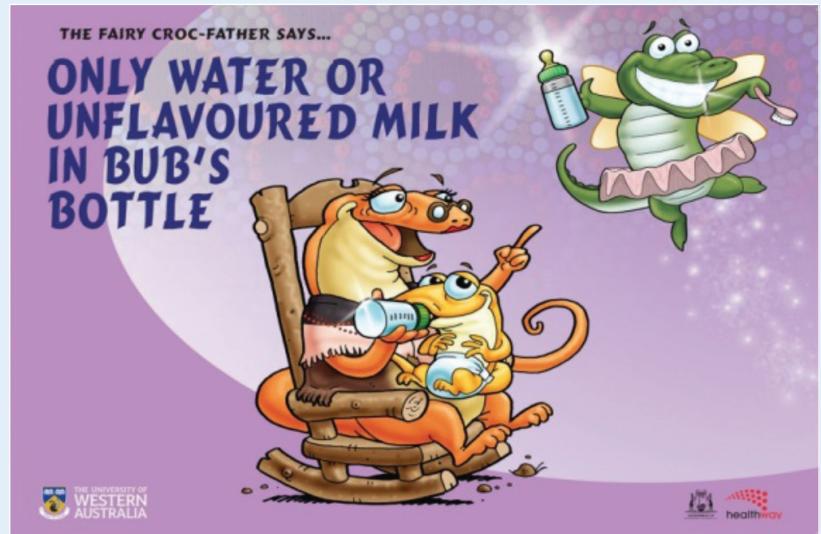
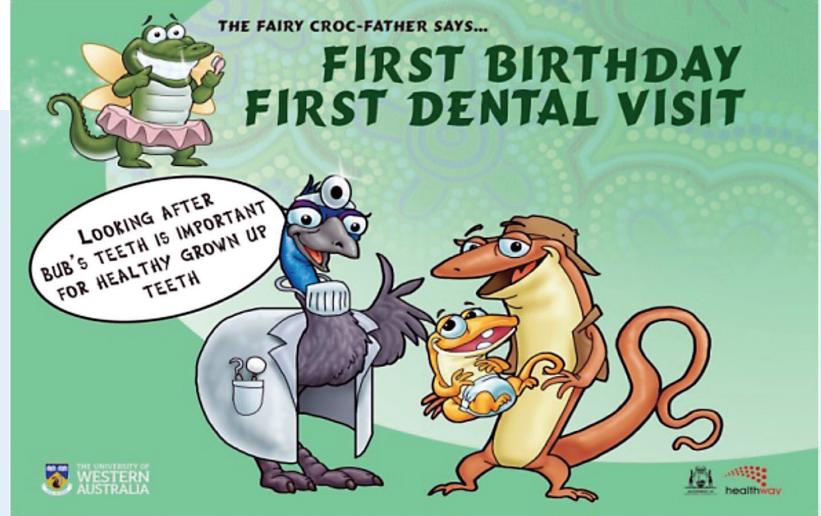
The Oral Health Inequities Group is now developing a story book promoting oral health for children 0-5 years and includes the Fairy Croc Father accompanying Gary Goanna to the Dentist. We acknowledge invaluable funding support from Healthway and we are keen to continue this work and continue working with the Aboriginal community and colleagues to develop and distribute oral health resources. However, we need your support. Details of the project and how to support us to further this work and obtain posters are on the chuffed website.

<https://chuffed.org/project/oralhealth-for-aboriginalchildren>

Many people helped to develop these materials and I would particularly like to acknowledge Dr Vanessa William and Dr Rebecca Williams who have always been very willing to assist with valuable feedback. When Angela asked me how I found such helpful people the answer was simple ANZSPD!!

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Rationale for use of space maintainers

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Introduction

Primary teeth begin their calcification at approximately 4 months in utero (Lunt & Law, 1974). Around the time of birth, a subsequent, permanent dentition starts to calcify in preparation for eruption, beginning around the age of six years (Logan & Kronfeld, 1933). This allows for the growth and development of the face and jaws, as well as providing sufficient function in terms of mastication, speech, aesthetics and social development.

In certain circumstances, primary and/or permanent teeth can be lost either due to dental trauma or extracted as a consequence of dental caries. Subsequent to the premature loss of a primary tooth, there may arise a need to intervene and prevent the possible sequelae such as space loss. Therefore, this article aims to discuss the rationale, indications, contraindications and considerations for space maintenance therapy in light of the existing literature. The merits of individual types of space maintainers are beyond the scope of the present article hence will not be discussed.

In the literature, there is inconsistency in the use of some terminologies; hence, Figure 1 illustrates the terminologies that will be used in the present article. When mentioning tooth types, descriptive terminology will be used including the terms "primary" and "permanent" to describe the two dentitions, e.g. first permanent molar, second primary molar.

Crowding in the primary dentition:

The primary dentition plays an important role in the growth and development of the child as well as the jaws. An intact primary dentition contributes to effective mastication and nutrition, speech, aesthetics, prevention of oral habits and facilitates the eruption of the permanent teeth. Characteristics of the primary dentition such as primate spaces influence the growth of the permanent dentition. In the classic article by Baume (1950), he

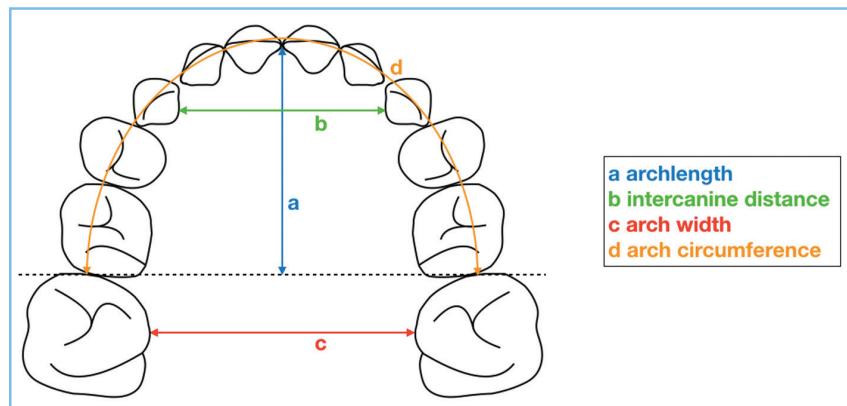


Figure 1: Illustrates the terminologies used namely (a) arch length, (b) intercanine distance, (c) arch width, and (d) arch circumference

noted that primate spaces were present in the primary dentitions of only 60% of patients. The patients without primate spaces, intercanine width was noted to be smaller, and 60% of these patients developed crowding in the mixed and permanent dentitions.

Ravn, in 1975, assessed the occlusal relationships of 310 children in Copenhagen and found a wide variation where 20% had asymmetrical canine relationships, over 30% had a primary molar relationship other than bilateral flush terminal plane, and 24% had generalised spacing of the maxillary arch, but only 15% in the mandible.

The transitional (mixed) dentition:

Lead by genetic and environmental factors, dental and skeletal growth as patient's transition from the primary to the permanent dentition results in many dimensional changes of the dental arches. In the transition from the primary to the permanent dentition, the primate spaces, especially in the mandible, is lost subsequent to the eruption of the first permanent molars. Baume (1950) termed this "early mesial shift" and reported that in most cases, it resulted in a Class I Angle's molar relationship. Moorrees and Reed (1965) assessed arch dimensions in

serial dental casts of 183 white American children and found that in the maxilla, arch length decreased between the ages of 4 and 6, but that this phenomenon was then overcompensated by eruption of the permanent incisors in a more labial position than their predecessors. No such compensation occurred in the mandible.

While transitioning from the late mixed to permanent dentition, significant space is gained in the form of leeway space – the difference in mesio-distal length between the primary canines and molars and their successors. The literature has consistently demonstrated that there is marked variation in leeway space between individuals. Bishara and co-workers (1988) found that in their study of 121 subjects, the mean leeway space was 1.2mm (SD 1.0mm) in the maxilla and 2.4mm (SD 1.0mm) in the mandible.

Further space is gained with an increase in intercanine width, which can be observed during eruption of the incisors in both jaws. Data from Moorrees & Reed (1965) demonstrates that following eruption of the incisors, the intercanine width plateaus in both jaws, however in the maxilla, the permanent canines erupt into a position of greater intercanine width – a phenomenon not observed in the mandible.

Also related to eruption of the permanent incisors is the concept of incisor liability. Described as the difference between the mesio-distal width of the primary and permanent incisors, Mayne (1975) reported an average incisor liability of 7.6mm in the maxilla and 6mm in the mandible. While the increase in intercanine width described above also contributes to the space required for the incisors, the concept of incisor liability highlights the importance of incisor spacing in the primary dentition. Baume (1950) found in his study that 100% of children with crowded primary anterior dentition also had a crowded permanent dentition.

Once in the permanent dentition, Bernabé & Flores-Mir (2006) reported in their study of 200 Peruvian children that 60% had at least mild crowding, although population differences would exist. Many factors including genetic and environmental factors influence the development of a tooth-size arch-length discrepancy (TSALD). Factors implicated in developing crowding include skeletal jaw size discrepancies, aberrations in eruption sequence, transposition of teeth, abnormal resorption of primary teeth, reduction of arch length due to interproximal caries, prolonged retention of primary teeth and premature loss of the primary teeth (Ngan et al, 1999).

Early loss of primary teeth:

Causes for early loss of primary teeth include caries and its sequelae, trauma, ectopic eruption, congenital or developmental disorders, and premature resorption of primary teeth due to TSALD. The effects of early loss of teeth can be both dental and non-dental.

Non-dental effects of early tooth loss can include effects on mastication, speech, and aesthetics. It is known that severe early-childhood caries has been associated with lower body weight in infants (Acs et al, 1992), and this would have flow-on effects once teeth are lost. Furthermore, certain consonants such as S and Z sounds may be affected by the early loss of anterior teeth (Adewumi et al, 2012).

Dental effects of premature tooth loss depend on several factors. A key consideration is the type of tooth or teeth that have been lost.

Primary incisors

Early loss of primary incisors does not share the same volume of focus in the literature as loss of primary molars.

Usually lost to either dental caries or a traumatic dental injury (Holan & Needleman, 2014), there is no consensus on the need for space maintenance following early loss of primary incisors. Baume (1950) has been quoted by many prior review papers as evidence for loss of arch length following early loss of primary incisors, particularly if the tooth is lost very early or if the patient has a distal step molar relationship or a deep overbite; however, it should be noted that this was a secondary finding from Baume's work and no study since has substantiated this claim. Clinch & Health (1960) followed 29 children for 11 years and found no loss of arch dimension in the few reported cases of early loss of anterior teeth. While many articles propose recommendations for space maintainers after early loss of primary incisors (Kohn 1961, MacGregor, 1964, Ngan et al 1999), they are largely based on expert opinion rather than scientific evidence.

Due to the aesthetic implications of early loss of primary incisors, the option of a fixed or removable prosthesis exists to restore appearance, and this may act as a space maintainer, but this is usually a secondary requirement and is not commonly reported in the literature (Huber, 1997). Furthermore, the concept of limiting transverse growth in growing children disfavours the use of fixed appliances, which is again based on anecdotal claims rather than sound scientific evidence.

Primary canines

Conventional wisdom incites that early loss of a primary canine can have implications on both anterior and posterior segments. Mills (1982) stated that early loss of a primary canine could result in mesial drift of the posterior segment. The majority of remaining literature is in the context of treatment of lower anterior crowding. In a case-control study, Sayin & Turkahramma (2006) extracted both primary mandibular canines in 16 patients with lower incisor crowding in the early mixed dentition. While these extractions were performed with the intention of manipulating arch dimensions, the authors observed that mild lingual tipping of primary incisors was noted in the patients allocated to the treatment group only. Foley and co-workers (1996) described a similar effect with associated reduction in the arch length and deepening of the bite. Brennen & Gianelly (2000) advocated the use of a lower lingual holding arch

following extraction of primary canines to prevent loss of arch length and reduction in effective leeway space. Furthermore, regarding the effect of early canine loss on dental midlines, loss of a single primary canine has been reported to result in tipping of the incisors into the space left after extraction, resulting in a deviated midline (Lewis, 1976). However, no specific data exists to support these claims as majority of it is based on expert opinion and case reports.

First primary molars

Liu (1949) was the first author to attempt to quantify the space lost after extraction of primary molars (see Table 1), however a major weakness was that it was cross-sectional data that was compared to available normative data from previous studies, and hence the several inconsistencies in the study findings.

Lin & Chang (1998) measured D+E space (from the distal surface of the primary canine to the distal surface of the second primary molar), arch width, arch length and arch perimeter following extraction of mandibular first primary molars. They noted significant shortening of the D+E space but no significant overall reduction in any other parameters. The authors concluded that the reduction of D+E space resulted in distal tipping of the primary canine rather than significant mesialisation of the second primary molars and first permanent molars.

Lin et al (2011) followed up 13 children one year after extraction of a single maxillary first primary molar and found a similar result with reduction in the D+E space, which was the only significant change in arch dimension. Lin & Lin (2017) followed up 10 patients of the same cohort after an average of 81 months and observed that significant distalisation of the primary canines was still the only significant result.

Lundstrom (1955) measured space loss after extraction of primary molars and concluded that significant space loss was only likely in patients who exhibited dental crowding, and patients with jaws of sufficient size to accommodate the full complement of teeth were unlikely to experience crowding in the permanent dentition, regardless of early loss of primary dentition. Ronnerman (1977) found that beyond the age of 7.5 years, space loss following extraction of first primary molars was insignificant. He reasoned that development of the succedaneous premolar is advanced

enough by this stage to allow for accelerated eruption – a theory supported by the work of Fanning (1962).

Ronnerman & Thilander (1978) assessed facial and dental arch morphology in children with and without early loss of primary molars and found TSALD associated with retrognathism to be the only predictive factor for crowding in the permanent dentition.

Second Primary Molars

In comparison to the first primary molars, some authors (Breakspeare 1951, Rosenzweig & Klein 1950) have found space closure following loss of second primary molars to be significantly greater in both arches. It was also found to be greater in the maxilla than the mandible. Nevertheless, the quality of available evidence to support these claims appears to be low, see Table 1.

The greater space loss following early loss of second primary molars is thought to be due to the mesial path of eruption of the first permanent molars. It is also thought to be faster in the maxilla due to the reduced bone density. In either arches, the effects of space loss are thought to be worse where second primary molars are lost prior to the eruption of the first permanent molars. Both Ronnerman (1977) and Czecholinski et al (1994) also found that early loss of second primary molars resulted in mesialisation of the first permanent molars as well as accelerated eruption of the second permanent molar. Czecholinski (1994) also found that if the primary molar was lost prior to the age of eight, eruption of the premolar was likely to be delayed.

Factors affecting space loss

There are three main factors affecting space loss after early loss of primary teeth namely, degree of crowding, type of tooth lost, and age of the child.

Degree of crowding

Baume (1950), Bernabe & Flore-Mir (2006), Lundstrom (1955) and Ronner & Thilander (1978) all found that crowding was more likely in patients who already had a TSALD, and less likely in those without. This demonstrates a relationship between the extent of existing crowding and the amount of further space loss following premature tooth loss.

Type of tooth lost

As discussed above, the type of tooth lost is critical in deciding whether further intervention is required. Whereas in some

Table 1

Author, Year	First primary molar		Second primary molar		Both primary molars	
	Mx	Mn	Mx	Mn	Mx	Mn
Liu, 1949	2.2	1.42	2.49	1.38	2.3	1.93
Breakspeare, 1951	2.1	2.6	5.0	3.3	–	–
Rosenzweig and Klein, 1950	1.3	1.7	3.0	2.0	–	–
Klein, 1950						

cases, no space maintenance is required, in others, balancing extractions or space maintainer appliances may be required.

Age of the child

Early loss of primary molars is more likely to further delay eruption of the successor (Fanning, 1962). Similarly, Ronnerman (1977) and Czecholinski and co-workers (1994) reported that due to the increased time between loss of the primary tooth and eruption of its successor, the younger the child is at the time of tooth loss, the more severe the space loss is likely to be.

Summary

The goal of space maintenance is to prevent loss of arch length, width and perimeter by maintaining the relative position of the existing dentition.

Some factors to consider include:

- Specific tooth lost
- Time elapsed since tooth lost (consider need for space maintenance, space regaining or whether there is any treatment need at all)
- Pre-existing occlusion
 - Overall dentoalveolar relationship
 - Intercuspalation of distal tooth with opponent
 - Over-eruption of opponent to tooth that is lost, preventing drift of adjacent teeth
- Spacing of existing dentition
- Presence and root development of successor tooth
- Patient factors including age, health status and cooperation
- Patient's oral hygiene and caries risk
- Likelihood of the patient to attend follow-up visits
- Type of space maintainer required
 - Consider longevity of space maintainers – unilateral space

maintainers, particular band and loops, have a longer expected survival time than bilateral space maintainers (Qudeimat & Fayle, 1998)

- Fixed space maintainers guarantee compliance and are not easily lost like removable appliance, however breakages are more common

Contraindications to use of space maintainers include:

- Permanent successor is close to eruption
- Permanent successor is missing
- High caries risk
- Unlikely to attend follow-up visits
- Low patient tolerance
- Other significant orthodontic treatment requirements indicating a more thorough orthodontic assessment and treatment plan
- Loss of first primary molars after 7.5 years of age (Ronnerman, 1977)

Majority of the recommendations are based on expert opinion and case reports, as there is no high quality scientific evidence available. In light of the scarcity of evidence on which to base guidelines and treatment decisions, space maintenance should be prescribed on a case-by-case, as-needed basis where no considerations contraindicate their use and it can be predicted that benefit will outweigh the treatment burden on the child.

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The Hall Technique Revisited

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Introduction

Dental caries remains one of the most common chronic childhood diseases and when left unmanaged, can be debilitating, significantly impacting on a child's growth and development, sleep, nutrition, learning, appearance and overall oral health-related quality of life¹⁻³. In children, primary molars are the most common tooth type to be affected by caries and these teeth are typically restored using preformed stainless steel crowns^{4,5}. Stainless steel crowns were first introduced to dentistry in 1950^{6,7} and have a wide range of indications in paediatric dentistry including⁸:

- i) caries involves multiple surfaces of a tooth
- ii) recurrent caries
- iii) after endodontic therapy
- iv) developmental defects of enamel
- v) fractures
- vi) bruxism
- vii) orthodontic or prosthetic appliance retention

There is strong evidence supporting the use of stainless steel crowns with studies suggesting a greater longevity when compared with direct intracoronal restorations^{9,10}. The conventional preparation for a stainless steel crown however, requires removal of carious tissue and sufficient occlusal and proximal reduction to allow the preformed crown to fit the tooth, and the procedure is typically carried out under local anaesthesia necessitating the need for adequate cooperation. Conversely, the 'Hall technique' is a minimally invasive procedure where a stainless steel crown is cemented with no local anaesthesia, no caries removal and no tooth preparation¹¹. This technique was first pioneered by Dr Norna Hall who used this to treat young children with high levels of untreated caries coupled with low levels of oral health literacy and expectations within the community¹². She found that bypassing some steps of the conventional stainless steel crown preparation, made restorative care more acceptable for both children and their parents without noticeably affecting the treatment outcome. Recently, the Hall technique has received considerable

attention with some authors describing it as the technique that will 'revolutionise children's dentistry' while others have criticized it to be a 'gross distortion of science and medicine'^{13,14}. Given the conflicting opinions in the literature, this paper aims to discuss the Hall technique in light of current evidence and the existing literature.

An untested and unsubstantiated approach?

Initially the Hall technique was described as an untried and 'wholly untested' restorative procedure unsubstantiated by scientific evidence¹⁵. Dean, in a letter to the British Dental Journal argues that the use of the Hall technique and incomplete caries removal without adequate informed consent may be breaching the ethical rights of children particularly in cases where conventional stainless steel crown placement with complete caries removal could be an option¹⁵. In response to this, Evans highlights the fact that the Hall technique was introduced in a rural community for high-risk children where access to care was limited. Furthermore, Evans notes that Dr Hall conducted a clinical audit in 1991 after placing 111 crowns using this technique and reported acceptable outcomes¹². This audit formed the basis of a pilot trial published in 2000 which aimed to determine the acceptability of the Hall technique to a range of dentists, patients, and their parents¹⁶. In regards to the level of scientific evidence, at the time, there were no randomised control trials to support the use of conventionally cemented stainless steel crowns let alone those placed using the newly described Hall technique. Evans concludes saying that "*instead of just wringing her hands about children's rights, Norna Hall, who practised in a remote and rural area with little specialist support, actively did something to help her child patients achieve their fundamental right to oral health and freedom from dental pain.*"¹⁵

A gross distortion of science and medicine?

Croll and co-workers describe the Hall technique as a 'shot cut non-repair approach' that attempts to quickly treat

a significant disease process regardless of an inferior result¹⁴. They raise several questions regarding the use of the technique namely:

- i) What are the histopathological implications of leaving caries and bacteria within a tooth?
- ii) What are the implications of 'entombing a caries infection rather than healing it'?
- iii) What is the impact of the soft tissues and occlusion when cementing an oversized crown

The traditional approach to caries management as described by G.V. Black, nearly a century ago, included the need for complete excavation of caries and removal of demineralised dentine and unsupported enamel¹⁷. At that time dental caries was considered an infection that could be cured using a surgical approach. Keyes in 1969 highlighted the influence of three key factors in the aetiology of dental caries: i) a susceptible host ii) cariogenic microflora iii) a suitable substrate (sugars)¹⁸. Over the years our understanding of the dental biofilm and its role in cariology has increased and this is marked by the introduction of the ecological plaque hypothesis by Marsh in 2003 and more recently the Keystone-Pathogen Hypothesis^{19,20}. Consequently, dental caries is no longer considered an infectious disease that needs to be "cured" by removing bacteria or, even less so, a particular bacterial species. Instead, dental caries can be managed by controlling its causative factors²¹.

Meta-analysis and systematic reviews of clinical studies have demonstrated that when access to fermentable substrates is blocked by a hermetically sealed restoration, bacteria do not appear capable of exerting their cariogenic potential resulting in caries arrest^{22,23}. Simply, isolation of a carious lesion from the oral environment will alter the plaque biofilm causing a shift in the distribution, type and proportion of plaque micro flora favouring caries arrest. The approach of 'sealing in' caries to prevent its progression is supported by studies investigating:

- i) placement of fissure sealants over existing carious lesions²⁴⁻²⁶

- ii) step-wise and partial caries removal^{23,27-29}, and
- iii) the Hall technique^{30,31}

If leaving caries behind still leaves the practitioner sceptical, Horst and co-workers propose a chemo-pharmacological approach by applying silver diamine fluoride (SDF) to the lesion prior to crown cementation³². The deep penetration of SDF acts as an antimicrobial, dentine protease inhibitor and remineralising agent, which alleviate the concerns of the caries being left, untreated. Horst and co-workers further advocate the use of the Hall technique to reduce the need for treatment under general anaesthesia and sedation, which carry additional risks particularly in children with compounding co-morbidities. The greater acceptability of the Hall technique may also reduce the need for restraint of children and thereby reduce future dental fear and anxiety, which may occur should traditional approaches be followed^{11,32}.

Hirsch proposes that the Hall technique can also be considered as a form of indirect pulp therapy and echoes the comments raised by Evans pointing to a lack of evidence supporting the superiority of the conventional stainless steel crown placement^{15,33}. Hirsch further asserts that the traditional surgical methods of caries management, i.e. drill and fill, are not a ringing endorsement of disease treatment with a significant portion of a practitioner's time being dedicated towards extracting teeth where conventional restorative treatments have failed³³. As a result the gold standard of care can be defined as when a treated primary tooth exfoliates asymptotically at its correct biological time of exfoliation³³.

Myers and co-workers reported that stainless steel crowns even when prepared using conventional techniques will result in a degree of surrounding inflammation³⁴. Recent randomised controlled trials assessing the Hall technique suggest no adverse effect on the soft tissues³⁵. In regards to resultant occlusal disharmony, primary teeth have the ability to adapt to small changes in occlusion such as that caused by cementation of a crown using the Hall technique^{36,37}. Prospective clinical studies have demonstrated that the occlusion re-establishes itself within 15 to 30 days following placement of the crown using the Hall technique^{36,37}.

Innes and her co-workers refer to the work of Thomas S. Kuhn, an American physicist, historian and philosopher

who describes how for most individuals, adopting new ways of thinking tends to be an all-or-nothing shift, rather than the gradual, sequential process that might be supposed^{38,39}. The authors suggest that a paradigm shift needs to occur within the dental profession to align with contemporary evidence on caries progression and the role of the biofilm in carious lesions. An informed understanding of the current evidence clearly shows that the traditional surgical model of care based on complete caries removal is over-simplified and outdated³⁹.

In conclusion, there is strong evidence to support the use of the Hall technique in high-risk children, which stems from a contemporary understanding of the caries biofilm, caries progression and its bio-medical management. The technique is one of several in the armamentarium of a paediatric dentist that can be used in managing caries following a consideration of each patient's individual risk factors. Inness and her co-workers capture the conflicting ideology asserting that "*the reasons underlying the failure of clinicians to translate evidence into clinical practice are many and complex, but the majority of problems can be loosely summarized as "don't know", "can't do", or "won't change"*"⁴⁰.

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